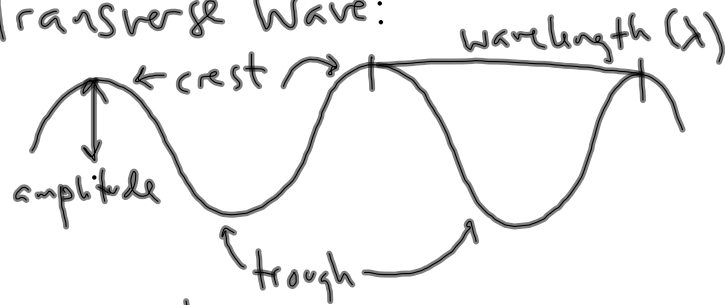


## Waves, Sound, and Light Review:

- Transverse Wave:



Period (T): time it takes for one complete wavelength  
measured in seconds

frequency (f): cycles per second  
measured in Hz

Wave speed:  $v = \lambda f = \frac{\lambda}{T}$

- Longitudinal waves



- Interference:

- Constructive  $\vec{\uparrow} \vec{\uparrow} \Rightarrow \uparrow$

- Destructive  $\vec{\uparrow} \vec{\downarrow} \Rightarrow \text{—}$

- Reflections at boundaries:

- Free end  $\rightarrow$  stays upright

- Fixed end  $\rightarrow$  flips

- Drawings

• Standing Waves:

- Node  $\rightarrow$  destructive interference
- Antinode  $\rightarrow$  constructive interference
- Drawings and eqns.

$$f_n = \frac{nv}{2L} \quad n = 1, 2, 3, \dots$$

• Standing Waves in pipes:

- Open/open:

$$f_n = \frac{nv}{2L} \quad n = 1, 2, 3, \dots$$

antinodes at both open ends

- Open/closed:

$$f_n = \frac{nv}{4L} \quad n = 1, 3, 5, \dots$$

antinode at open end  
node at closed end

• Doppler effect:

( ( ( • ) ) ) ) )       $\phi$  shorter  $\lambda$ ,  
so higher  $f$

$\phi$  longer  $\lambda$ ,  
so lower  $f$

• Sound travels fastest through solids

• Intensity:  $I = \frac{P}{4\pi r^2}$

- Decibels are the typical scale

• Pitch  $\rightarrow$  measure of frequency

- Light:
  - Wave/particle duality  $\rightarrow$  we can think of light as either
  - Light can do three things when encountering a new medium:
    1. transmission  $\rightarrow$  refraction
    2. absorption
    3. reflection
- Does not need a medium
- $c \rightarrow$  speed of light in a vacuum  
 $3 \times 10^8 \text{ m/s}$
- index of refraction:
$$n = \frac{c}{v}$$
- technical name is electromagnetic radiation
- electromagnetic spectrum
- types of reflection:
  - diffuse  $\rightarrow$  random
  - spectral  $\rightarrow$  coherent
- Snell's law  $\rightarrow n_1 \sin \theta_1 = n_2 \sin \theta_2$

• Types of Mirrors:

– Flat → virtual, upright,  
same size

– Concave  
object is:

image is:

1) at infinity

point formed at  
focal point

2) outside C

inverted, real, smaller  
(between C and F)

3) at C

inverted, real, same size  
(at C)

4) bet. C and F

inverted, real, larger  
(outside C)

5) at F

no image formed

6) inside F

virtual, upright,  
larger  
(on right side of  
drawing)

$$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$$

$$M = -\frac{d_i}{d_o} = \frac{h_i}{h_o}$$

– Convex → image virtual,  
upright, smaller

obj. height = 20 cm  
image height = 60 cm

Concave mirror  
obj. distance is  
10 cm

find  $M$ ,  $d_i$ ,  $f$

image characteristics

$$M = \frac{h_i}{h_o} = \frac{60 \text{ cm}}{20 \text{ cm}} = 3$$

$$M = -\frac{d_i}{d_o} \quad d_i = -30 \text{ cm}$$

$$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$$

$$f = 15 \text{ cm}$$



CONVEX mirror

obj. distance = 10 cm

obj. height = 4 cm

$f = -5$  cm

find  $h_i, d_i, M$ , image characteristics

$$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$$

$$d_i = -3.3 \text{ cm}$$

$$M = -\frac{d_i}{d_o} = 0.33$$

$$M = \frac{h_i}{h_o}$$

$$h_i = 1.33 \text{ cm}$$

image characteristics: virtual, smaller, upright

